DOCUMENT RESUME

ED 345 214 CS 010 936

AUTHOR Jones, Miles R.
TITLE The Effects of Training with Time Compressed Speech Plus Text on Reading Speed, Vocabulary, and Comprehension.
PUB DATE 86
NOTE 70p.; Figures 5 and 6 may not reproduce well.
PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Listening Skills; Literature Reviews; *Reading Comprehension; *Reading Rate; *Reading Research; *Speech Compression; Theory Practice Relationship; Vocabulary
IDENTIFIERS Skimming (Reading)

ABSTRACT

This paper reviews the literature on the effects of training with time compressed speech (TCS) plus text on reading speed, vocabulary, and comprehension. The first section of the paper presents an introduction and outline of the findings. The second section summarizes and critiques 15 studies on training with TCS published from 1954 to 1985. The third section discusses the effect of listening skill development on reading. The fourth section presents a summary and generalization of the findings that training with TCS plus text appears to be effective at increasing reading speed and vocabulary with no loss of comprehension. The paper suggests that "comprehension asymptote" (the preferred level of comprehension, or the percentage of reading material understood by an individual reader) is critical as the regulator of reading skills development. (Two tables and eight figures of data are included; 16 references are attached.) (RS)

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THE EFFECTS OF TRAINING WITH TIME COMPRESSED SPEECH PLUS TEXT ON READING SPEED, VOCABULARY, AND COMPREHENSION

Miles R Jones,PhD
World Book Encyclopedia

1986

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The Effects of Training with Time Compressed Speech plus Text on Reading Speed, Vocabulary, and Comprehension

ABSTRACT

Training with Time Compressed Speech (TCS) plus text appears to be effective at increasing reading speed and vocabulary with no loss of comprehension. This is the conclusion drawn from the critique of experimentation dealing specifically with reading practice paced by compressed (speeded) speech of the text. Each relevant study is summarized and critiqued. Criteria are extracted that contribute to success using the technique. The Comprehension Asymptote, the preferred level of comprehension, is suggested as the regulator of reading skills development. Relevant generalizations are drawn from the broad research on TCS and reading development.

Miles A. Jones, PhD
World Book Encyclopedia
1986

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The Effect of Training with Time Compressed Speech Plus Text on Reading Speed, Vocabulary, And Comprehension

An enormous amount of research has been done on accelerated speech. Duker's (1974) annotated bibliography Time Compressed Speech has almost five hundred entries. Although practically all of the work on time compressed speech (TCS) has focused on listening comprehension, such a well laid research foundation has brought us to an enhanced awareness of the relationship between speech production and reading ability.

We learn the spoken language long before the written language. When we learn to read we use the phonetic code of the alphabet. We see the letter symbols that spell out the word(s); we decode them into sound; and we retrieve the sense of the word(s) from memory. This SYMBOL-SOUND-SENSE decoding progression is reading. The mental and physiological internalization of the sounding out of the symbols is subvocalization. The organs and muscles involved in speech production make minute physical response to the stimulus of reading. Reading is a process of phonetic decoding and it conditions us to make the subvocalization response. Because of this, the ability to read is tied to the ability to speak.

The relationship between rate of speech and rate of reading has been noted and will be discussed in the later portion of this report. The average rate of speech (200 words per minute (wpm) plus or minus 25 wpm) corresponds closely with the average reading speed in the general population (200-250 wpm). Regarding TCS, the highest speeds

at which TCS can be comprehended (between 500-600 wpm) also represent the highest speeds at which one can read and comprehend each and every sentence in a passage (Carver,1985). Reading beyond this speed is accomplished by selectively reading only the most important parts of the text. This valuable reading skill is more precisely known as "skimming" and can be developed to impressive rates of speed, depending upon the depth of knowledge required of the reading material.

The fact that skimming is an effective learning tool points out how capable the human brain is of abstracting and absorbing information. One clear conclusion of this review of the research is that even untrained subjects can absorb information at approximately double the normal rate (by either reading-listening or listening alone) with little or no loss of comprehension. The faster material is presented the more apparent it becomes that simultaneous reading-listening is the optimal mode for practice.

The technique of reading-listening is such a standard for early reading development that it seems only natural that continuing the practice at higher speeds would be effective. However, the technology for this technique has only recently become available. Until now it has seemed more appropriate to use methods that simply force the eyes to move faster over the page. This would force the brain to practice speeding up the decoding/subvocalization process. However, READING OCCURS IN THE BRAIN NOT THE EYES! Training with TCS plus text offers advantages that appear to be improvements over previous theory and practice in reading development.

Theory and practice are the why and how of educational research and application. In practice, TCS training with text has been consistently effective in increasing reading speed and vocabulary with no loss of comprehension (see Table 1). In theory, using TCS plus text makes reading easier by doing part of the work for the brain, that is, by providing the (speeded) subvocalization portion of the Symbol-Sound-Sense reading progression. By providing this speeded subvocalization imprint, TCS also gradually conditions the brain to a faster response to the stimulus of reading the printed text. Improving reading skills takes concentration and effort. The use of TCS appears to aid in focusing concentration and to require less effort to enhance performance.

Typically, the subvocalization barrier has not been dealt with in reading development, except perhaps to instruct the reader not to subvocalize. Rather than hand the reader such an improbable task, TCS approaches the barrier by conditioning the reader to accelerate the internal subvocalization. Vocabulary development, comprehension, and reading speed are all dependent upon each other. Each word the individual does not know, or has trouble pronouncing, becomes a stumbling block to effective reading. Acquisition of vocabulary increases comprehension and removes obstacles to reading speed. Increased comprehension of context aids vocabulary development and augments reading speed by decreasing the number of regressions. Faster reading speeds acquisition of vocabulary and aids comprehension by increasing concentration and interest.

Summary of Research using TCS plus Text

(+ indicates increase)
(= indicates no loss/no gain)
(- indicates decrease)

Educ Level of Subjects	Research Reference	yr.	Comprehension	Vocabulary	Speed	Total Time Training with TCS (est)	WPM rates Used
High school	Thames	'72	=	+	+	2.5-4 hrs	150-350 wpm
College	Olsen	'72	= *			.13 (8 min)	250
College	Orr	'66	=		+	.5-1	225-425
College	Parker	'70	= (1)			2.3-3	175-350
High school	Rawls	'70	=		+	1.5-3	175-350
Grade 6	Reiland	'70	=		=	1.5-3	175-300
Grade 6	Walker	'70	=	+ =	+ = (3)	3-6	175-350
College	Jester	'74	= * (2)			.6-1	200-400
[illegible]	Reid	'71	=	+		1.5-3	125-225
Grade 5	Bruland	'70	+ = * (4)	=	+	1.5-3	175-275
College	Reidford	'65	+ *			2-6	185-480
Adult	Shennum	'75	+		+	3-6	75-375
Grade 7	Kling & Reiland	'68	= (5)	+	+	.5-1	175-300
Students	Stromer	'54	=		+	20-24	247-285
Grade 4	Johnson	'71	-		+ (6)	1.5-3	150-275

Table 1

* indicates comprehension testing of reading aided by TCS, those without asterisks indicate post testing unaided by TCS

(1) except for lowest aptitude subjects whose comprehension declined somewhat at high speeds

(2) comprehension of untrained subjects rose up until about 350 wpm where a sharp decline did occur

(3) gains in reading rate were not maintained in postesting 6 wks later vocabulary gains apparently were no higher than those of controls who read only

(4) significant and consistently higher gains on daily tests- no significantly higher scores on delayed tests & Gates-McGintie

(5) Reiland's comments that comprehension "tended to decline" indicates the loss was not significant

(6) Both treatment and control groups showed the same results

All types of pacing devices have been used to improve reading skills. Many of these devices have been found to be effective at improving reading speed (Tinker,1967). A finding reported over and over again with pacing devices and conventional reading improvement programs is that they make moderate gains in reading speed with no change in the level of comprehension (Harris,1968). With research on the use of TCS plus text the results are almost uniform. Aided by TCS, speed may increase to 2½ times the normal rate with no loss or gain in comprehension. The Comprehension Asymptote is suggested as a possible explanation of this phenomenon.

It is theorized that an individual will develop up to a certain level (or range) of comprehension that they find satisfies their need to understand the material they are reading. Since every individual's tolerance of ambiguity is different, this Comprehension Asymptote may be unique for each individual as well. This asymptote soon becomes a habitual regulating mechanism for further reading development (see Figure 1). The Comprehension Asymptote refers to the percentage of reading material understood by the reader. It is very important that the asymptote not be confused with the amount of information learned. If a reader doubles their speed and retains the same percentage comprehended then their index of learning efficiency is twice what it was.

This report is organized with the most relevant data first. We will proceed to the most important research that has led to our conclusions, and last to outline the more general information supporting the assertations made here.

Theory of the Comprehension Asymptote

Optimal/Preferred Level of Comprehension regulates reading skills

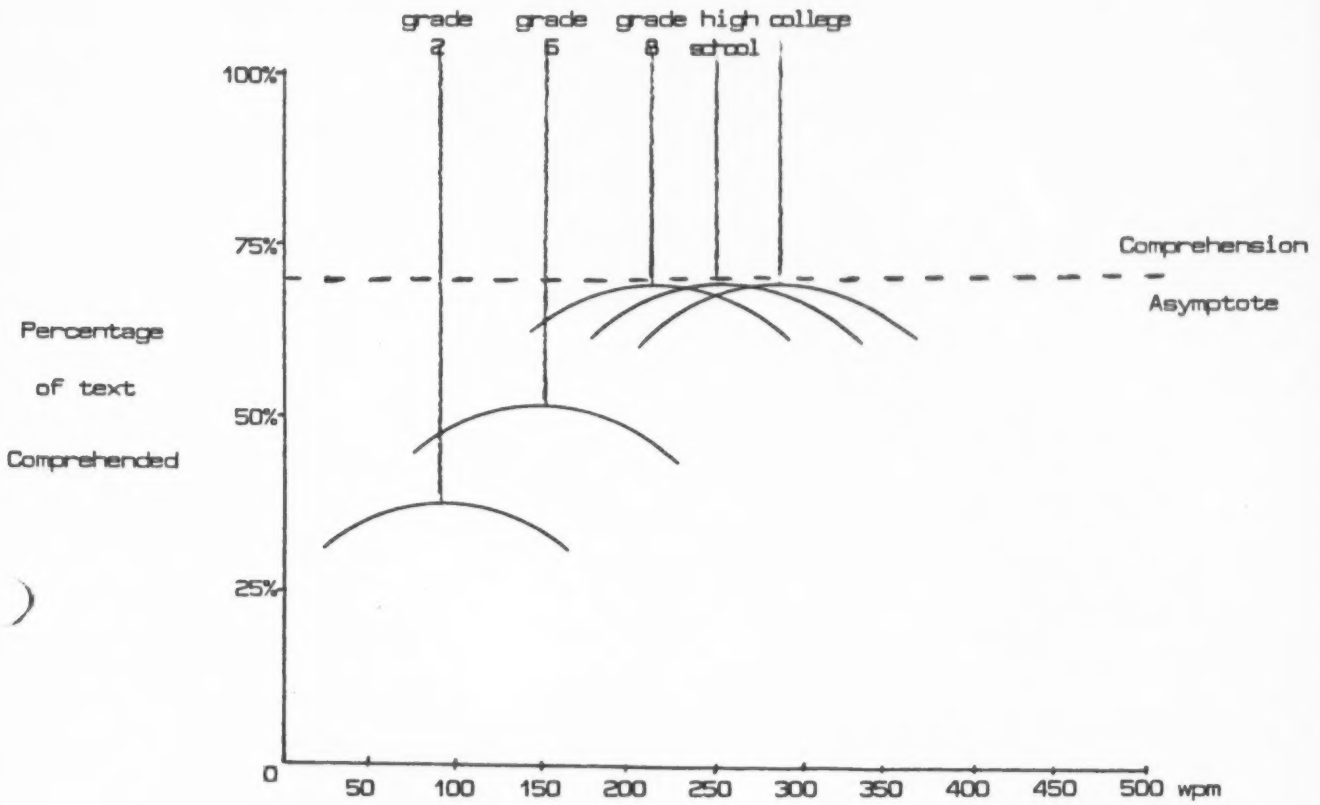


Figure 1

I Each individual has a different tolerance of ambiguity.

II Once a satisfactory (or optimal) level of comprehension (the asymptote) is developed, it becomes habitual behavior.

III If reading is difficult (comprehension is low), speed is slowed until asymptote is reached.

IV If reading is easy (comprehension is high), then speed is increased until asymptote is reached.

V Improvement in reading and comprehension skills leads to a demonstrable increase in vocabulary and speed, level of comprehension remains the same.

Critique of Studies on Training with TCS plus Text

Kenneth H Thames (1971)

The purpose of Thames' study was to determine if 46 high school students using TCS as a pacer would show greater gains in reading rate and listening ability than those who practiced reading only. Ten short stories were taken from the anthologies Adventures in Appreciation and Striving. The sessions were administered on succesive days as part of regular English classes. The evaluation was done with the Brown-Carlsen listening Comprehension Test and the Nelson-Denny Reading Test. Two stories were presented each day to the TCS group beginning at 150 wpm and increasing 50 wpm each day to a high of 350 wpm during the final session. The control group read the stories without TCS. The groups were pre and post tested in exactly the same way. Alternate forms of the Brown-Carlsen and the Nelson-Denny were used to avoid repeating reading passages. Actual exposure to TCS training is estimated at 2½ to 4 hours maximum. The results showed that the TCS group improved significantly more than the control group in reading rate and vocabulary, but no significant difference was found on the reading comprehension subtest.

Critique of Thames

Thames spent 60% of the time going no faster than the probable average reading/listening rate of his subjects. Possibly not until they reached 300-350 wpm were their abilities actually stretched. Other research indicates that gradually increasing speed is no more effective than starting at double present capacity and maintaining practice at that level. (see Friedman, Appendix B ,page 521)

Robert Emile Jester (1966)

An elaborate set-up was devised for this experiment using headphones and a 35mm filmstrip (white letters on black background) with one or two sentences per frame. The passages were from textbooks, stories, humorous writings, scientific reports, and other types of reading material. The 90 subjects were paid participants; college students, mainly from the University of Utah. The purpose was to test comprehension at various rates of presentation with and without text or audio. The three modes were Audio (only tape), Visual (only text), and Audio-Visual (text and tape). Each subject underwent an exposure to TCS of approximately one hour for the whole procedure. They started at a rate of 200 wpm moving up to 400 wpm, increasing in increments of 50 wpm - comprehension being tested at each level. The Davis Reading Tests were used to evaluate comprehension. The results showed very little decline in the comprehension of these untrained subjects up to a speed of about 350 wpm where there was a sharp decline in comprehension in all modalities (see Figure 2).

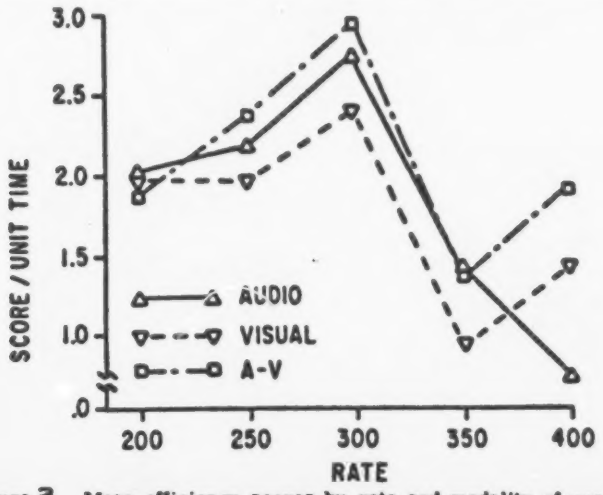


Figure 2 Mean efficiency scores by rate and modality of presentation (n=18 per cell). Jester, in Duker (1974:832)

The simultaneous Audio-Visual (AV) mode produced consistently higher comprehension scores. Jester concludes that the highest efficiency for all modalities is at 300 wpm. He hypothesizes that AV mode was superior because subjects select the modality best suited for them when given the choice, and block the other modality. He further hypothesizes this is because visual material can be scanned, grasping larger units at once, which is impossible to do auditorily - accounting for the low audio only scores.

Critique of Jester

Jester considers 140 wpm to be normal speaking so that 300 wpm is twice the "normal" rate. However, 300 wpm is the average reading speed for college students(Carver,1985), such as Jester's subjects. It is hard to imagine them being unable to handle an increase in speed maybe only 25% beyond their present capacity. It does not seem unusual, though, that first exposure to TCS plus text at high speeds would result in substantial initial disorientation. It does seem significant that this drop in comprehension does not continue but begins to rise again (in AV and V mode) at even higher rates of presentation.

Jester's procedure allowed for equal amounts of time viewing each film frame of 80 words or less. The human brain is not so consistent, taking more time to recognize and comprehend some sentences than others. The inflexibility of such a technique may adversely affect comprehension.

Modality blocking, choosing one's preferred mode of information processing and blocking the others, was first suggested by Broadbent (1956). It deserves careful con-

sideration. AV scores were lower than Visual or Audio scores at slowest speed, why? Since this speed was probably slower than their reading speed anyway, it may be that they attempted to block the audio portion in order to focus on reading faster and the resulting confusion or distraction decreased concentration and comprehension. Again during first introduction to speeds beyond their normal reading capability they may have reflexively attempted to focus attention only on their strongest mode in an unsuccessful attempt to keep up. In both cases, the initial disorientation seemed to be overcome quickly as comprehension scores showed immediate increase following both periods. This would indicate caution at beginning below a learner's reading level as well as an initial disorientation period in processing TCS at high speed. Although comprehension scores were initially higher with TCS, the drop at 350 wpm evens out the scores when averaged all together.

Clement Cordell Parker (1970)

Parker conducted this experiment to determine what rate of compression and modality produced the best comprehension among 18 classes of junior college students. The modalities consisted of Aural Only (audio) and Aural-Ocular (audio-visual). He used three rates of presentation; 1) zero compression (about 175-200 wpm), 2) 1/3 compression (about 260-300 wpm), and 3) 1/2 compression (about 350-400 wpm est.). Seven passages were taken from the Nelson-Denny reading Comprehension Subtest. The groups were further subdivided into ability levels - low, medium, and high aptitude groups by administration of the Guilford-Zimmerman Aptitude Survey. The actual exposure to TCS was anywhere from 140-182 minutes, depending upon the amount of compression used.

Parker's conclusion was that the Aural-Ocular mode was the only one showing no loss of comprehension even at the fastest rate, with the exception of the lowest aptitude subjects. The low aptitude Aural-Ocular group did have better comprehension than did the low aptitude Aural Only group at the fastest rate, although comprehension was significantly less at 1/2 compression than at 1/3 compression. Medium and high aptitude Aural-Ocular subjects suffered no loss of comprehension even at highest speed.

Critique of Parker

Parker does not inform us of how many words per minute he considers "normal" or zero compression. The most likely range would be 175-200 wpm no compression, 260-300 wpm at 1/3 compression, and 350-400 wpm at 1/2 compression. If so,

given a bit more exposure and flexibility than in Jester's procedure, these untrained subjects retained full comprehension at rates apparently higher than those used by Jester. The lesser capacity of low aptitude groups is a finding that will be repeated in other research. Although it is unsettling to think that some junior college students have not reached a level of ease in reading comprehension (the asymptote), that may well be the explanation for this finding.

Sister Mary Luke Reiland (1970)

Reiland investigated the potential usefulness of TCS as a reading improvement technique with sixth graders. The 428 subjects (21 classes) were randomly assigned as Listening-Reading (LR), Listening Only (LO), and Reading Only (RO) groups. Minor factors to be examined were differences possibly caused by intelligence, as determined by SRA Tests of general ability. The reading materials (18 stories) were taken from the Reader's Digest Skill Builders (Book 5,I,II,&III). They were recorded at 140-150 wpm and compressed to speeds of 175,200,225,250,275, and 300 wpm.

> There were three stories for each of six word rates, ranging from 175 to 300 words per minute. This procedure allowed for an increment of a 25 word-per-minute increase for each week during the training or practice sessions. The selection of the stories was such that the listening time remained substantially the same throughout the practice sessions. That is, as the rate of speed increased, the stories grew longer. (Reiland,1970:80)

Although Reiland does not say, we estimate total time spent training with TCS at approximately 1.5-3 hours.

The subjects were pretested with the STEP Listening Test and the Gates-McGintie Reading Test, level D, designed for 4th through 6th grade. Since about 30% of the subjects were close to the ceiling scores on the Gates-McGintie level D - the decision was made to post test with level E, designed for 7th through 9th grades. The results were scaled in order to adjust for the differential in test difficulty.

The results showed that "there was a slight but observable trend...for subjects who had training in simultaneously reading and listening to perform better...when reading comprehension was measured" (ibid.,p.147). These differences

were not significant, however. The results also show no difference between low, medium, and high intelligence subjects based on the experimental treatment, an unlikely result. In fact, an examination of Reiland's findings show no significant differences between pre test and post test scores for any group regardless of level of intelligence, experimental treatment, or sex for either reading speed or comprehension, despite six weeks of training and practice.

Critique of Reiland

Other research on TCS gives us reason to question whether gradually incrementing increases in TCS is the most effective technique. Reiland spends 85% of her time working up to 1/2 compression (twice normal speed), therefore her subjects actually spend little time training at high speed with TCS. This may be appropriate for sixth graders but not enough information is given to attempt such an evaluation. A critique of TCS research in general is that subjects reading speeds (in wpm) are seldom given, nor are approximations offered. Granted there is criticism that words-per-minute is an imperfect index, it remains the only one we have for setting appropriate training speeds for readers using TCS.

Reiland's study includes what must be considered a fatal flaw in her testing procedure. Her decision to post test using level E of the Gates-McGintie was in error. The pre test was done using level D (4th-6th grade), while level E is intended for grades 7 through 9. More difficult reading material effectively lowers both comprehension and speed, wiping out any possible gains due to practice or treatment.

We do not need to elaborate on the difference in difficulty of a pre test appropriate for 4th graders and a post test appropriate for 9th graders. If Reiland's decision was appropriate for the 30% of subjects approaching ceiling scores on level D of the Gates-McGintie, then it was certainly not appropriate for the 70% who had not reached that ceiling. Scaling scores does not adjust for inappropriate testing procedure.

One of the most consistent findings in our research review is that reading practice, in almost any form, leads to increase in reading skills. Reiland's results not only go against this improvement-through-practice factor, but they also go against research on training with TCS plus text showing gains in reading skills. There is evidence to support the assertation that Reiland's testing procedure was fatally flawed. Fortuitously, Reiland conducted a pilot study testing the experimental design with results that confirm our research evaluation.

Kling and Reiland (1968)

Kling and Reiland, "Compression Boosts Reading Rate"(1968), conducted a pilot study that served as a prelude to Reiland's dissertation study. Thirty subjects were randomly assigned to three treatment groups: Listening Only (LO), Reading Only (RO), and Reading-Listening (LR). Six 700 word passages from Wide,Wide World (a reading text from Scott,Foresman & Co.) were compressed at six different rates from 175-300 wpm, allowing a 25 wpm increase each lesson for six days. Pre and post testing were done with the Gates Reading Survey. All three groups gained in reading rate with the Listening-Reading group showing a significantly higher gain than the others. The LR group also showed a significant gain in reading vocabulary. Reiland states that reading comprehension "tended" to decline for all three groups, indicating that these losses were not statistically significant.

Critique of Kling and Reiland

Explaining the different result between the pilot and the major study should have been a main theme of the discussion section of Reiland's dissertation. It was ignored. Failure to identify the pre/post testing differential as a limitation of her study is inexcusable.

Richard Anthony Bruland (1970)

Three 5th grade classes (117 students) were tested for IQ (using the Peabody Picture Vocabulary Test) and divided into low, average, or high ability groups, then assigned randomly (but evenly) into one of four treatment groups: Listening Only at normal rate, Reading-Listening at normal rate, Listening Only at compressed rate, and Reading-Listening at compressed rate. The normal rate was about 175 wpm, while the TCS rate (36% compression) was about 275 wpm. In addition, a reference only group was given pre and post tests with no treatment or training at all. They also took the daily tests without having read the stories.

Twenty stories at 5th grade level were selected to accompany social studies topics on history and geography of the Americas. Total training time with TCS was about 120 minutes (est.). Comprehension (recall of information) tests, consisting of ten multiple choice questions, were given after each story. The Gates-McGintie (level D) and STEP Listening Test were also given in pre and post testing.

The results showed that the TCS groups consistently performed better on recall of information. "The differences between the two rates of presentation are not great. They do, however, consistently favor the performance of the compressed group" (Bruland,1970:68). The Reading-Listening mode, in addition, showed clear statistical superiority "across all tests, across all days, and across both rates of presentation" (ibid.,p.69). Only at the low ability level did subjects learn more at a normal

rate (in Listening-Reading mode).

Although the compressed Reading-Listening groups showed clear gains over the other groups on testing of the specific information covered in reading practice, this did not carry over to the general skills testing on the Gates-McGintie. Bruland lists it as a limitation of his study that "if a standardized silent reading test had been chosen that was more similar in format to the treatment tests, performance on a test of this nature might have been significantly affected" (op.cit.,p.72). The Gates-McGintie measures comprehension, speed and accuracy, and vocabulary. The speed and accuracy portion measures the number of questions attempted against the number correct. It is designed to measure how fast the subject is reading with understanding. The RL compressed subjects were clearly superior in number of questions attempted, with mean gains of 6.39 (twice that of the normal rate group) as compared to the overall average gain 4.46. The number of questions correctly answered was right at the overall average gain. The RL compressed subjects vocabulary scores were also right around the overall average gain. (There is some doubt about this since there is apparently a calculation error in Bruland's data, the correction of which would notably favor RL compressed group subjects). The overall average of all subjects' comprehension scores was .99, as compared to the RL compressed group's 1.52. This difference was not statistically significant. Bruland concludes that these gains show no more than normal growth.

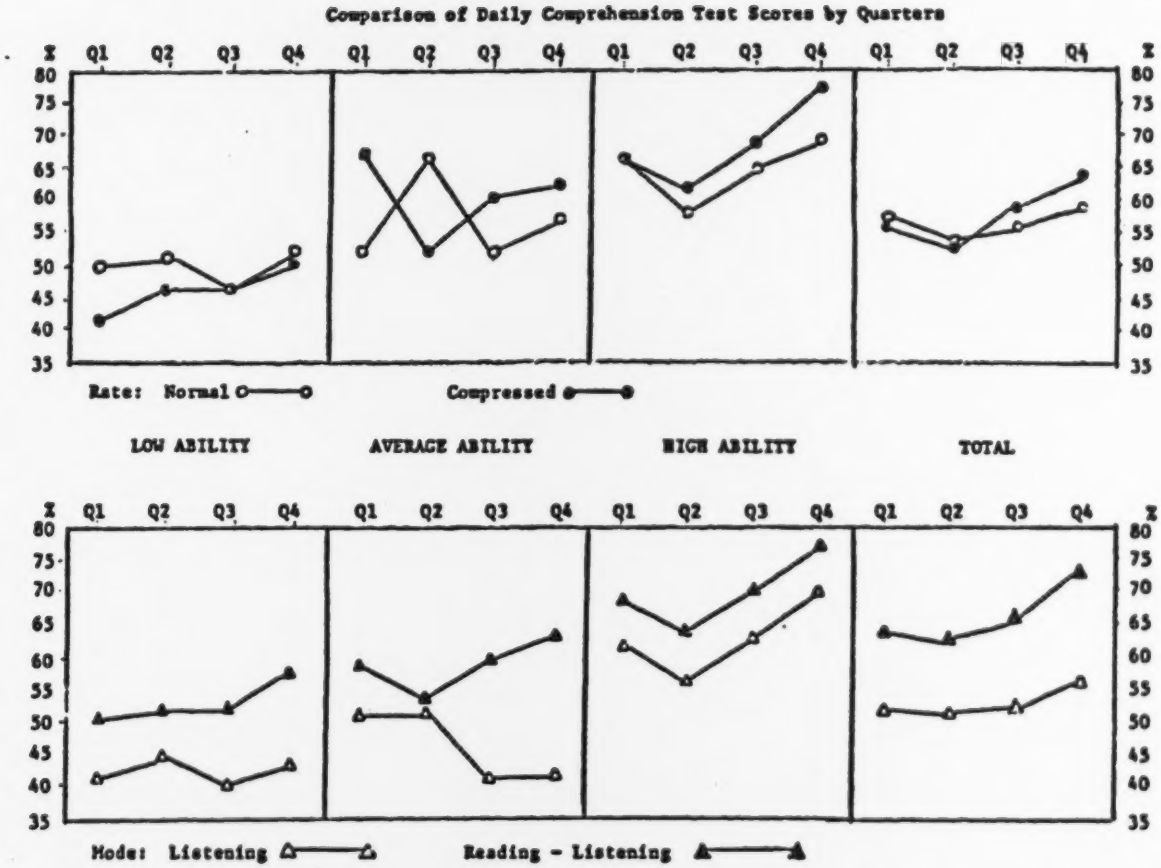


Figure 3 - From Bruland (1970:59)

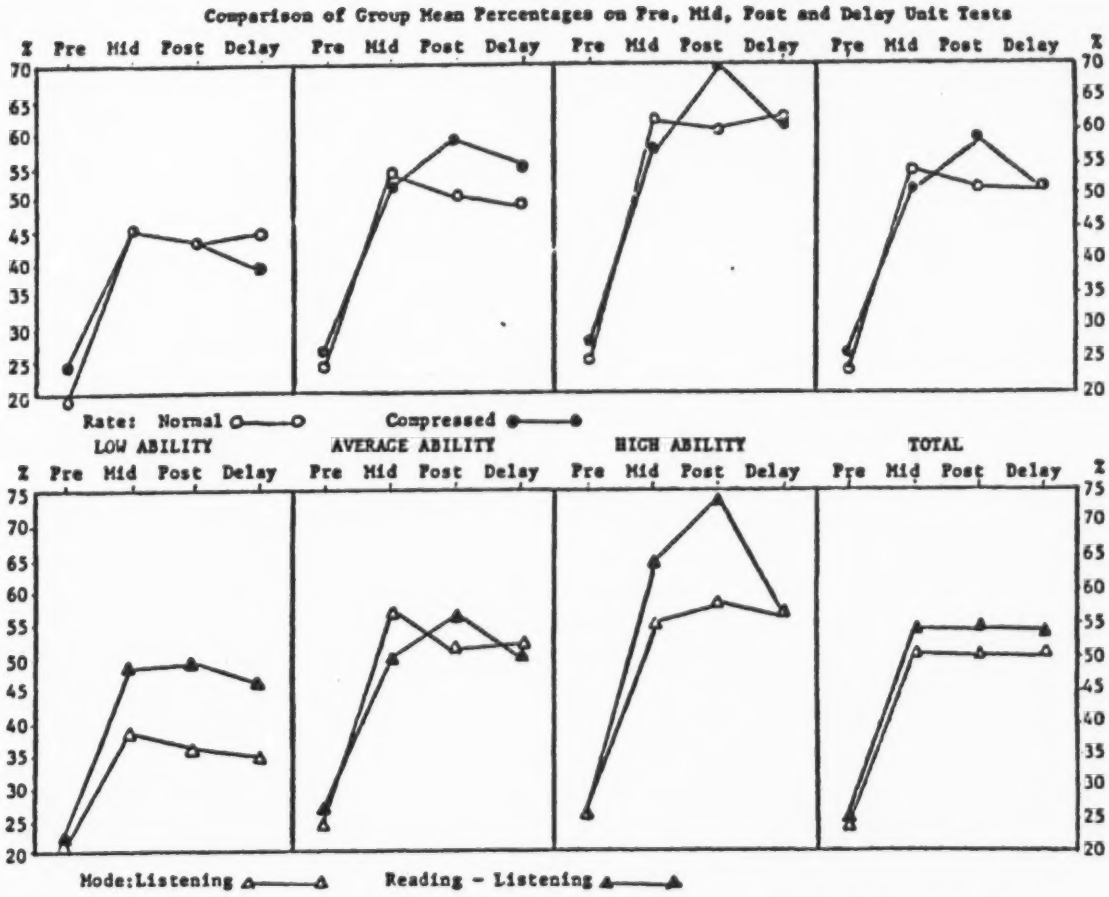


Figure 4 - From Bruland (1970:50)

Critique of Bruland

The basic premise of the Gates-McGintie Reading Tests (and the Nelson-Denny, for that matter) is to establish the general level of reading achievement of individual students. It may serve as the basis for further individual diagnosis or evaluate the general effects of instructional programs. "For the purpose of reading diagnosis it lacks the specificity to identify weaknesses" (Rupley,in Mitchell, 1985:596). These types of generalized survey tests were not intended to measure the effects of short-term improvement programs such as the experimental research we are reviewing. They lack the specificity. For example, it is questionable whether a measure of the number of questions attempted in the Speed and Accuracy subtest is a reliable index of reading speed. Unless one expects that an experimental program will boost reading skills by a grade level, general survey tests are a poor choice for evaluation of studies of this sort. It seems remarkable that noticeable gains were evident from these surveys of Bruland's program, since the subjects had only about 1.5-3 hours training with TCS maximum. The fact that superior tendencies were evident for the TCS Reading-Listening groups is encouraging. The lack of statistical significance for these gains, given the very short period of training, is not surprising.

The testing of the specific information covered in the reading material almost certainly is the most reliable index of gain in this context. The fact that the impressive gains made by the RL compressed subjects on daily comprehension tests were not maintained in delayed testing six weeks later

makes some sense. Both retention of information and retention of skills require consistent practice. It seems certain that minimal training with no follow-up is not effective in the long run.

David B Orr (1966)

Orr conducted a study specifically designed to test carryover on reading rate from practice with TCS. He recorded ten historical passages (1000-2000 words each) at 175 wpm. The ten subjects (college students) read and listened to the passages compressed to 425 wpm during four sessions over three weeks time. They were pre and post tested using the Nelson-Denny Reading Test and the STEP Listening Test. They were tested on multiple choice questions after each passage.

The results showed that the experimental subjects improved significantly in reading rate with no gain or loss in comprehension. The mean improvement for the experimental group was 90 wpm, as opposed to 10 wpm gain for the control group.

Critique of Orr

Few of the researchers reviewed have considered it important to relate exactly how much time the subjects actually spent training with TCS plus text. In Orr's case we have enough information at least to form a reliable estimate. We know there were nine passages used in training from 1,000-2,000 words each and they were presented at 425 wpm. This gives us a minimum of 21 minutes, and a maximum of 42 minutes training with TCS plus text. It should be noted that this is much less than the time supposedly used by Bruland's 5th graders. However, generally Orr's subjects were far superior readers and practiced at much higher speed. These factors will be discussed at length later in this report.

Phillip A Reidford (1965)

Reidford questioned the validity of findings reported by Orr et al. (1965) that practice with TCS increased reading skills. She tested the effect of training with TCS on comprehension attempting to control factors such as motivation and mental set. She used 84 college student subjects, volunteers for a non-credit reading improvement course. Alice in Wonderland was recorded at seven word rates (185-480 wpm). There were nine training sessions of 40 minutes each. The subjects were randomly assigned within categories of: male with book, male no book, female with book, female no book. The control group started at 0% compression and increased to 40% compression (top speed about 320 wpm) over the nine sessions,while the experimental group started at 40% compression and increased to 65% (top speed of 480 wpm).

The pre and post testing was conducted with a Perceptoscope, a video device that projects reading material and paces the reading rate by shading one line after another. Four films were used, each testing one of four speeds from 185-480 wpm. Ten multiple choice questions were presented after each film. Pre and post testing were exactly identical except for the reading material used on the films. Reidford's analysis claimed no observable treatment effects. All subjects showed statistically significant gains in comprehension except at the highest level of compression (480 wpm). Reidford attributes that overall improvement may be due to factors of motivation and mental set. Total training time with TCS is estimated to be between 2-6 hours, depending upon how much time was occupied with comprehension testing.

Critique of Reidford

It is hard to shake the feeling of bias from Reidford's procedure and analysis. All subjects (even controls) received rather extensive training with TCS, half with text, and half without. All subjects showed comparable gains in comprehension aided by a rapid reading device. That is a treatment effect! There is no reason to assign that effect to factors of motivation and mental set rather than the experimental treatment.

Other research with TCS shows that incrementing increases in presentation rate is about as effective as simply starting at a higher rate. Therefore, Reidford's "control" group was actually another treatment group, receiving a slightly different version of the experimental training with TCS, although at a somewhat lower rate of presentation.

The research has consistently shown that even untrained subjects can increase their speed with no loss of comprehension when aided by a mechanical pacing device (Tinker,1967) such as Reidford's Perceptoscope. Any real gain from the training procedure must be measured by testing the unaided reading rate and comprehension. Reidford's sole use of the Perceptoscope in testing leveled any real difference in the subjects' abilities that might be apparent without artificial aid. Most importantly, Reidford incorrectly states that gains made in rapid reading comprehension were not due to training with compressed speech -- a statement inconsistent with his results. All subjects trained with TCS. All subjects showed significant gains in rapid reading comprehension.

Rachel F Rawls (1970)

The total population of a high school for the visually impaired was used to form three treatment groups and a control group for this study. They were divided according to preference for braille or printed text. The Gilmore Oral Reading Test was used in pre and post testing since it is available in both braille and print. The STEP Listening Test, the Brown-Carlsen Test of Listening Comprehension, and the Slosson Oral Reading Test (SORT) were also used.

Group one (Listening Only) had 16 practice session, each followed by a comprehension test. They began listening at normal speed which was increased gradually to 10,20,30, 40,and 50% compression. Group two (Reading-Listening) used the same procedure except that they had the written text in either braille or print in front of them while they listened. Group three had essentially the same procedure as group one (Listening Only) but it was preceded by five sessions of listening to modified types of the EDL's Listen and Read course.

All three groups significantly improved their listening skills for both compressed and uncompressed material. Group two (Reading-Listening) was the only one to show a significant improvement in reading rate of printed material. Braille reading is a slower process to begin with and was not improved by the training with TCS plus braille. No difference in comprehension was found between pre and post testing. Predictably, the visually impaired subjects' comprehension declined at faster speeds. Auditory alone has been shown to be less effective at high speeds (Jester,1974) and with visual impairment, the support of the text would be lessened.

Saralou Reid (1971)

Sixty 2nd graders served as subjects for this experiment using TCS at 125,175,& 225 wpm. Subjects were divided into four subgroups according to reading achievement levels as determined by the Stanford Diagnostic Reading Test (SDRT) which was used for both pre and post testing. The SDRT has seven subtests: vocabulary, auditory discrimination, syllabication, beginning and ending sounds, blending, sound discrimination, and general reading ability level.

One set of subgroups only listened to the stories while another set of subgroups listened while reading. Sixteen selections were made from children's literature and recorded at 125 wpm even though "many children in the second grade read silently and orally at rates lower than 125 wpm" (Reid,in Duker,1972:854). Estimated training with TCS 1.5-3 hrs.

The results showed that vocabulary scores increased significantly for subjects in the Reading-Listening experimental groups but not for subjects in the Listening Only groups. All subjects made significant gains in auditory discrimination at 175 wpm.

Critique of Reid

Modality blocking becomes a major consideration when dealing with young readers, low ability readers, the educable mentally retarded, and the visually impaired. Reid's comment that many children read slower than 125 wpm indicates they had not mastered the phonetic decoding process well enough to reach their comprehension asymptote, the point of fairly instant and easy comprehension of text on one's reading level. Examining the reason for maximum

gains in auditory discrimination at 175 wpm, Reid speculated that "the 125 wpm rate was too low...the 225 wpm rate was too fast...while 175 wpm would be considered a normal rate of speaking when literature is presented orally"(op.cit., p.859). Given this input, it does not seem unreasonable that some students, to some degree, may have blocked struggling through the reading process in favor of fairly effortless listening. This would explain the gains in auditory discrimination and the relative lack of gains in reading skills. Reading speed was not tested. There was no loss of comprehension at speeds used (125-225wpm),as would be expected with either Reading-Listening or Listening Only. Training time with TCS was low (1.5-3 hours).

Charles Robert Walker (1970)

Walker compared the use of TCS plus text with the Preston-Botel Self Improvement Method, using 70 6th grade students in accelerated classes. He used the Landmark Book Series, which included comprehension tests after each selection, and a delayed post test. Subjects were also pre and post tested with the Gates Reading Survey. A third group of controls was also pre and post tested. They chose their own reading material and read for 15 minutes daily, the same amount of time spent reading by the other groups.

The Self-Improvement group subject using the Landmark Series was instructed "to time himself and force himself to read more rapidly, and...keep a graphic record of his performance" (Walker,1970:25). Both groups were tested with a 10 item multiple choice test after each passage.

The TCS group was divided into four subgroups according to reading rate as determined by the Landmark Series pre test. This was done to help individualize the program as much as possible. At first, the groups read and listened at a rate as close as possible to their actual reading rate. When it was established by the daily comprehension tests plus informal feedback that the subjects could "maintain a certain level of comprehension" then the rate was increased from 10% initially to a possible maximum of 50% compression. The TCS subjects were instructed "that they should always be reading for understanding and that if understanding does not occur, then there is no value in increasing ones rate" (ibid.,p.28). The study lasted six weeks with 15 minutes of training daily

about 3-6 hours total. Presumably that time frame includes testing. Toward the end, use of TCS was faded to encourage the subjects to continue reading at that same rate. Before the reading passage was finished, the tape would be stopped and the subjects would finish the passage reading only.

"Overall the study indicated that the Compressed Speech method and the Preston-Botel method both produced immediate gains and helped children increase their rate of reading without losing comprehension" (op.cit.,p.67). In delayed post testing six weeks later, the gains were not maintained for either group.

Critique of Walker

Walker's study is a good model for the effectiveness of individualized self improvement, although we would expect accelerated students to be more motivated than most. The Preston-Botel subjects apparently had complete freedom to individually determine their own rate. Dividing the compressed subjects into four ability level subgroups was an attempt to maintain, somewhat, this individualization. The TCS subgroups, however, did not determine their own rate. It was determined for them based upon a vague comprehension criteria that was not specified. Whatever the acceptable level of comprehension was, only the highest ability subgroup ever reached 50% compression (twice normal speed). The other three ability subgroups reached final levels of 45%,35%,and 25%, respectively. The lowest ability group actually trained at slower than normal speeds for the first week. Judging from the results of other research, Walker's approach was excellent for low ability subjects and much

slower than necessary for average and high ability readers. Actually, very little training with TCS at high speed took place. High speed being that level at which training is necessary to maintain comprehension, about twice normal and higher.

Walker's instructions to the two groups seem at odds. The Preston-Botel group was urged to force themselves to read faster, while the TCS group was admonished that they should always read for understanding or there was no value in increasing rate. Walker's apparent belief that students could not comprehend TCS easily is not justified by other research and could have biased the outcome. The fact that one group was free to proceed as fast as they wanted and the TCS group was not adds another question.

Nevertheless, Walker's procedure appears to be an excellent model for training with TCS with the addition of specific comprehension criteria appropriate for each ability level. Additionally, the self improvement method used seems to be an excellent follow-up for individual study. The lack of lasting gains in this study makes it clear that consistent and continuing effort is necessary to maintain or improve reading skills, no great surprise.

William A Shennum (and others)(1975)

This study was done using 26 subjects with low reading ability assigned to the Navy's 3-6 week Academic Remedial Training (ART) program. Although there were few subjects in each group, they received 12 hours of training. Four groups were used: group one Read and Listened using TCS, group two Listened Only using TCS, group three Read Only, and group four (control) took the pre and post tests only. The material used was an 8th grade level novel of 40,000 words (160 pages) plus two 1,000 word short stories. Comprehension was tested by a modified cloze test where every other noun was deleted and the subjects chose the correct insertion from a list. Multiple choice questions were used on the short stories.

The subjects selected their initial TCS rate. Rates used ranged from 75-375 wpm. They were instructed to increase the rate until the maximum speed they could comprehend. Each day the use of TCS was faded back (10% of TCS cut from total lesson time each day) from 100% initially to 40% on the last day.

The results show a higher gain for the Reading-Listening TCS group. Shennum, however, considers that the gains were sizable, but comparable, for all groups. He hypothesizes that the subjects might not have reach their comprehension asymptote, which would affect the outcome. The results are tabulated on the following page.

	initial scores	training high scores	post test scores	total improvement	
RL group	110/115 wpm	205/210 wpm	180 wpm	70 wpm	reading rate
	32%	58%	56%	24%	comprehension
LO group	120 wpm	218 wpm	170 wpm	50 wpm	reading rate
	45%	68%	53%	10%	comprehension
RO group	110 wpm	150 wpm	165 wpm	60 wpm	reading rate
	35%	62%	59%	24%	comprehension

Table 2

*Controls showed no change between pre and post testing.

Critique of Shennum

Shennum's procedure appears very much like the individualized approach used by Walker, even including the fading of TCS support gradually. Like Walker, he gets sizable increases for all methods used. Unlike Walker, however, all of Shennum's Navy personnel were engaged in a remedial program where they "were exposed to hours of reading instruction daily. The shear amount of classroom and other learning experiences may have equalized trainees, such that 12 hours of experimental intervention could not override this larger instructional impact" (Shennum, 1975:16). It is, undoubtedly, this influence that prevents us from seeing any possible significant differences in gains made because of the various treatments. Shennum introduces the concept of the comprehension asymptote.

Janet S Olson (1985)

Olson was investigating the comprehension of rate modified speech with technical material. Her subjects were 40 graduate students exposed to either normal or compressed audiotape versions of the Dwyer heart script. The treatments were: normal rate-no augmentation(text), compressed rate-no augmentation, compressed rate with text, and compressed rate with visuals (line drawings). Material was presented at 150 or 250 wpm. The presentation took 8 minutes at 250 wpm (2,000 words).

The pre and post tests measured spatial analysis, spatial restructuring, recall of specific information, and interrelationships of information. "Findings indicate that compressed messages do not differ in instructional effectiveness from normal rate messages for presenting technical information" (Olson,1985:1). However, she found that different rates were not equally effective for all instructional objectives. The rate of presentation and the use of text or visuals is dependent upon the type of learning task. Note that 250 wpm is indeed compressed in relation to normal speaking rate, but it is probably a normal reading rate for graduate students dealing with slightly difficult technical reading.

Walter Francis Stromer (1954)

Stromer compared the effects of silent reading versus simultaneous reading-listening upon comprehension using rates from 247-285 wpm. Subjects were divided into good and poor listeners as measured by a listening test. The Wechsler-Bellevue Intelligence Scale was used as well as the Diagnostic Reading Test.

Stromer found that:

> Combined reading-listening training, in which students were given considerable training in reading...while listening to simultaneous recording of material at speeds up to 285 words per minute, seemed to produce significant improvements in rate of reading, but produced almost no improvement in silent-reading comprehension. (Stromer, 1954:160)

Improvements in listening comprehension were small and not statistically significant. Both narrative type material and study material were used. Reading-listening proved to be significantly superior to reading-only for narrative type material, when comprehension was tested. With study type material, both modes provided equal comprehension. The subjects were trained two hours a week for one quarter. If all of this time was spent training with TCS (doubtful) instead of testing, then it totals an impressive 20-24 hours of training. Since this is far more time than any other researcher dedicated to training with TCS, it would be very interesting had Stromer used higher rates than 285 wpm.

Janet Mae Johnson (1971)

Johnson used 72 4th grade students as subjects. They were categorized according to ability level (low, medium, high) and randomly assigned to one of three groups; the compressed speech group, the timed-test group, or the control group. The study took 18 days over a two month period. The subjects read two stories from the Readers Digest Skill Builders, Grade Three, Parts I,II,& III. In the compressed group the first story was read and listened to at speeds starting at 150 wpm and going up every three days by 25 wpm to a high of 275 wpm. The second story was read without TCS support and the subjects were encouraged to maintain the reading rate they had achieved. The total time spent training with TCS over the 18 days is estimated at 1.5-3 hrs. The timed-test group used the same procedure as the compressed group did for the second story. They were timed on both stores and encouraged, presumably, to maintain a faster rate. The controls remained in the regular classroom.

The subjects were pre and post tested with the Gates McGintie Reading Tests, Survey D. They were tested after each story for comprehension. All three groups showed an increase in reading rate and a decline in comprehension over the two month testing period. Johnson's conclusion was that "Standard classroom reading instruction, with no particular emphasis on reading speed, seemed to be just as effective for improving reading rate as either of the experimental treatments used in this study" (Dissertation Abstracts,1971:3864-A).

Critique of Johnson

Little can be said about Johnson's procedure or analysis until the dissertation is obtained for study. The total time spent training with TCS was small, 1.5-3 hours. We would expect that with 4th graders, who surely had not reached their Comprehension Asymptote, slowed speech rather than speeded speech would be a more effective technique. This probably accounts for the decline in comprehension as well as the increase in reading rate. The subjects were encouraged to increase their reading rate, and they did so, at the expense of comprehension. It is becoming apparent that the asymptote is a crux point for readers, and that we must think in terms of variable rate technique - where the level of competence in reading comprehension determines whether to use expanded (slowed) speech or compressed (speeded) speech in reading practice.

The fact that all three groups showed equivalent results needs to be examined carefully. We know that practice with TCS plus text is effective. We also know that methods such as the time-test technique used by Johnson also can produce results. As far as the control group is concerned, what is "standard classroom reading instruction"? If subjects using artificial apparatus can double their reading rate without loss of comprehension then it's certain that reading is a skill that is greatly underutilized. This can amount to a lot of slack in evaluation procedure. Were Johnson's control subjects also encouraged to read faster? If not, then why should they display a decline in comprehension?

Effect of Listening Skill Development on Reading

Comprehension is the key factor in our investigation of the interrelationship between listening and reading, often considered the passive pair of the four language skills of listening, speaking, reading, and writing. This is far from true. Listening to and decoding the meaning of speech is quite a unique process. It is much different from listening to other sounds and equally different from the experience of a child or foreigner listening to a language they do not understand. Although the decoding of speech sounds into meaning becomes an automatic process; manipulating memory, conceptualizing, and making meaningful connections in order to better comprehend the message are very active mental processes. Sticht (1974) coined the term "auding" for the specific act of listening to speech in order to "language", that is, decode and conceptualize the properly ordered sequence of signs we call language. Auding is the dominant comprehension skill in the early years until the child reaches asymptote, after which reading becomes a more efficient means of learning and comprehending in many circumstances.

Reading, like auding, is also a process of decoding language signs in order to comprehend meaning. Where the auder decodes meaning from the spoken word, the reader decodes the spoken word from the printed page then accesses the meaning. For early reading development there is no real disagreement that reading involves a stage of decoding the printed word into inner speech. "Essentially, the reading process is one of using printed and written symbols...as cues to

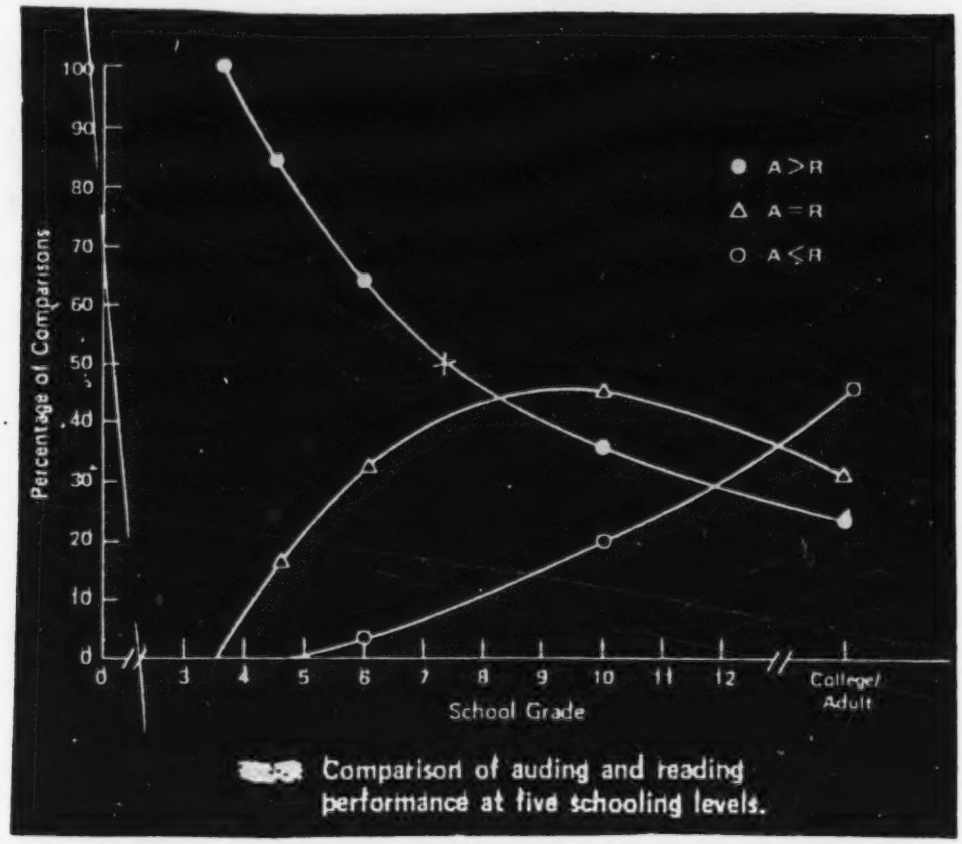
construct some kind of representation of a spoken message" (Carroll,1971:133). As Sticht puts it, "the internal language used in reading is the oral language used in speaking and auding" (Sticht,1974:53). Indeed, although the learner recognizes larger and larger blocks of letters, then entire words and phrases, he still "depends to a large extent on cues from the letters composing the word...there is little evidence to support the idea that a mature reader recognizes words merely by their outline or general shape" - (Carroll,in Singer & Ruddell,1970:293-4). As the decoding process becomes automatic, the learner approaches their asymptote of reading comprehension.

"Automaticity" (Samuels & Dahl,1973) means more than accurate and immediate word recognition. Decoding has to become a process that can be done without paying attention. If the reader must focus their attention on decoding, then comprehension will suffer. The decoding process is done "preattentively" while the attention is focused on conceptualizing the content, so that we seem to 'directly' perceive the meaning of the printed page (Sticht,1974). The phonetic decoding becomes automatic, but languaging requires active manipulation of memory and conceptualization. The 'passive' process of 'silent' reading is neither passive nor silent.

The notion of languaging emphasizes the unitary process behind all four language skills. The development of the receptive skills of listening and reading, in general, preceed the development of the productive skills of speaking and writing, although there is considerable overlap and codevelopment. The correlations that concern us are between listening,speaking,and reading. In the context of our research evaluation 'listening' refers to the specific process of listening to and comprehending speech, or auding, and the two terms may be used interchangeably. Although it is stating the obvious that good listening skill usually indicates good speech production, it is a correlation that is seldom, if ever, mentioned in most comparisons between listening and reading. It looms largely in our evaluation. Speaking ability (vocalization) is an inherent part of the correlation between listening skill and reading ability because of the subvocalization factor. How many good silent readers are there that are not also good oral readers? The author's position is that the difference between oral reading and silent reading is the difference between vocalization and subvocalization. Subvocalization, being only a partial and minute physical response, is faster and easier.

In the early years of learning and schooling, listening comprehension (auding performance) will be the stronger and preferred process over reading. The point at which reading performance equals auding performance is the comprehension asymptote, what Sticht calls "mature" reading (1974:67). Sticht's comparison of 44 studies measuring the relative

performance of auding versus reading is graphed in Figure 5, below.



——— Figure 5 ———

The 'X' on the chart indicates the approximate point where reading competency typically equals auding competency, between 7th and 8th grade. On the adult/college level only about half the cases show an increase in reading competency over auding competency, "suggesting that some college students and adults never achieve superior efficiency in gathering information by looking at print" (op.cit.,p.67). That finding is confirmed by U.S. Census Bureau studies showing 13% illiteracy (in English) in the general population. That figure rises to 20% if we consider 'functional' illiteracy, and 34% if we consider those who cannot perform everyday

reading tasks easily or well. Almost 1% (.8%) of these illiterates have some college, 6% are high school graduates, and 18.6% have some high school.

The correlation between listening skill and reading ability has been widely examined and supported (Goldstein, 1940),(Sticht,1974),(Loban,1964) and others. The relationship becomes most readily apparent after asymptote is reached, after reading decoding skills are thoroughly learned. Early learners are nearly homogeneous in their illiteracy. As reading decoding skills improve, learners utilize more and more of their oral language skills. Low correlations in primary schooling increase steadily over the school years. Sticht's analysis of longitudinal data from Loban (1964) shows this hypothesis to be so (see graph p.69, Appendix A). "One of the major implications of these findings is that training in oracy skills should not be expected to have much effect on reading comprehension until after the decoding skills of reading have been acquired" (1974:73). Sticht's composite from dozens of works studying the correlation between auding and reading is illustrated in figure 6. Few of the studies meet the precise criteria necessary for this figure to accurately quantify the correlation at various grade levels. The general trend, however, is quite evident.

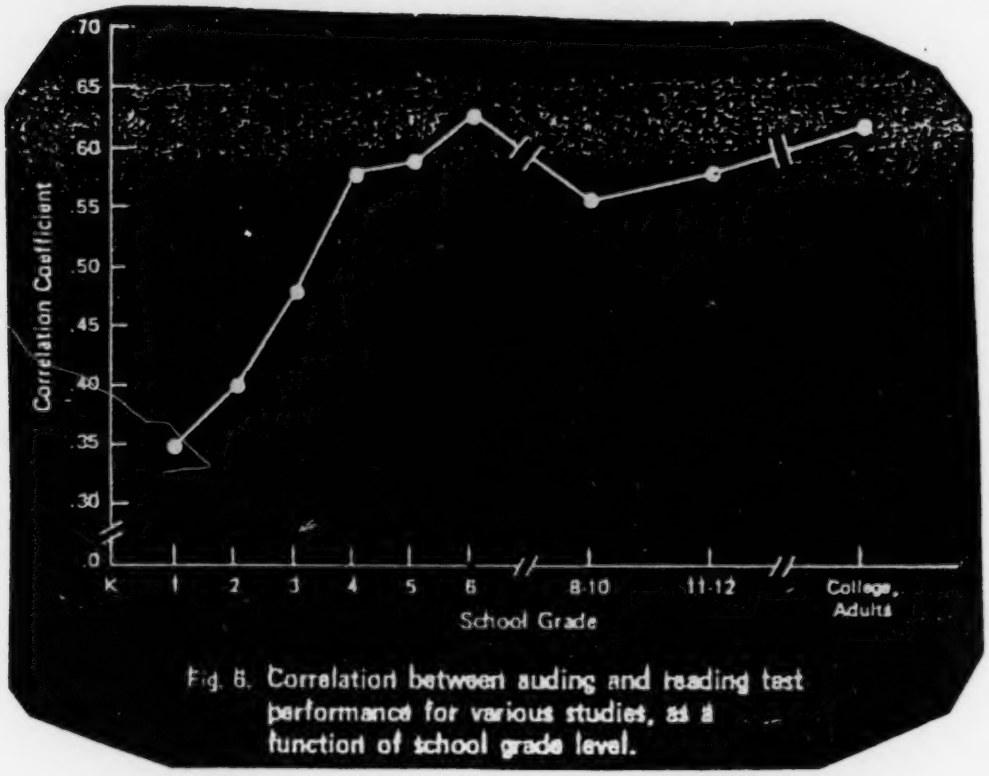


Fig. 6. Correlation between auding and reading test performance for various studies, as a function of school grade level.

It follows that there should be a relationship evident between auding and reading rates. As has been noted, average speaking and reading rates are in roughly the same range. It is hard to be any more specific since there is little agreement on what 'normal' speaking rate is, as well as valid criticism of the wpm index as variable and imprecise (Carroll, 1967). In reality, there are various rates for various purposes. Although 175±25 is the most often quoted range for reading aloud of literature, normal conversation can and often does proceed (significantly) faster. Trained rapid talkers can speak intelligibly at rates of 280-345 wpm (Harris, 1960). This fairly accurately pegs the levels at which comprehension of TCS begins to decline significantly in untrained subjects (Carver, 1973a)(Jester, 1974)(Langford, 1968)(Rossiter, 1970)(and many others). The relative ease of subvocalization,

as opposed to vocalization, would account for the average ability to read at rates of 250-300 wpm or more, which is the normal range of high school and college students (Carver, 1985). Past 500-600 wpm the best trained subjects' comprehension of compressed speech (without text) is too low to be effective (Cramer, 1967). Comprehensive reading tops out at this same level.

Carver (1985) did an excellent analysis of speed readers, spending considerable time, effort, and money to get the most proficient speed readers available. The results showed that all superior reading groups read relatively easy material at 300-600 wpm when 75% (comp.) is required. The conclusion from his various procedures was that "speed readers seem to be quite similar in ability to other superior readers except that they typically choose to skim at rates higher than 1,000 words per minute and accept the lowered comprehension that accompanies skimming" (ibid., p.389). The abilities of these groups of superior readers to basically read and comprehend each sentence of text ranged from 268-444 wpm, with exceptional individuals reading as fast as 600 wpm with 75% comprehension. This is aligned with the limits of ability to effectively understand compressed speech. Our hypothesis is that subvocalization can proceed apace, being only a partial and minute physical response as compared to vocalization. The outer limits of listening and reading (not skimming) appear to be the same, and we assume the outer limit of subvocalization is also the same.

More precise experimentation needs to be done to prove the subvocalization hypothesis, although Sticht (1974) makes a convincing argument from existing research, concluding that "both auding and reading rates of college students seem to correspond to the upper rates at which oral reading can be produced. This suggests a common factor underlying all three processes" (op.cit.,p.76).

> Research reviewed indicated that: (a) Typical oral reading rates for professional oral readers (newsmen; readers for "talking books" for the blind) are around 175 wpm, with a standard deviation of 25 wpm, hence auding rates of 175 wpm are typical for persons auding such presentations. (b) A national sample of 17-year olds and young adults silently read at rates of 185-195 wpm, suggesting that, typically, such persons do not read silently much faster than they aud newscasts or radio programs. (c) When requested to read aloud as rapidly as possible without loss of intelligibility, trained oral readers can produce speech rates as high as 250-340 wpm. (d) When adults are presented spoken materials for rapid auding, comprehension typically holds up well for speech rates up to 250-300 wpm, then declines more rapidly. (e) A national sample of 17-year olds and adults showed less than 10% of the population reading above 300 wpm, with the 75th percentile reading at 231-247 wpm; additional studies indicate that high school students and college students--that is, the better readers in the country--typically read at rates of 250-300 wpm. (f) Studies which have directly compared the effectiveness of auding and reading, at different rates of presentation of the material up to 350 wpm, show comparable levels of comprehension for the two processes at the fastest rates. (ibid.,p.78-9)

The current controversy over subvocalization exemplifies a kind of floundering about not uncommon in educational theory. Unfortunately, classroom practice is often based upon such floundering theory. It is often thought that the proficient reader extracts the meaning from the printed text without decoding it into a phonological stream of subvocalized

inner speech. This is called 'reading for meaning' and the importance of getting readers to shift to this higher level of proficiency is stressed so much that "some educators are suggesting that reading out loud may be detrimental to a beginning reader by impeding the shift, and all reading experts agree that subvocalization during silent reading is a bad habit in need of remediation" (Saville-Troike, 1973:396). The rationale is offered that because deaf children learn to read without phonetic decoding, so too can and should normal children learn to read without the 'bad' habit of subvocalization. Undoubtedly, this has been a motivating factor in the change from teaching reading by phonics to teaching whole words by sight recognition.

Some theorists apparently yearn to recommend that we bypass use of the phonetic properties of the alphabet in teaching reading, in order to avoid the need to remediate subvocalization habits later. "Although reading aloud is usually recommended for establishing the sound/symbol relation which is beneficial in decoding new words, research has indicated that enough potentially bad side-effects may occur for me to discourage this practice. Listening while looking may be a better way of achieving the same objective" (ibid., p.400 -- in reference to teaching English to speakers of other languages). Others, like Gough (1972), theorize that there is not possibly enough time for subvocalization to take place in rapid reading, a theory we have seen amply disproven by Sticht (1974) and others.

It matters not whether one decodes a word by sounding out its elements, or by sounding it whole on sight, it is still a phonetic process. Nor does it matter that the deaf circumvent the symbol-sound-sense progression in learning to read. As long as children learn the spoken language before the written language, sound will mediate their search for meaning from print. The symbolic-phonetic representation of speech is our most fundamental concept of written language. Toying with the idea of bypassing the phonetic process in teaching reading is unthinkable, irresponsible, and reflects a shallow understanding of the processes involved. Subvocalization, as a conditioned response to the stimulus of reading, is a necessity. It cannot be avoided and it seems entirely in error to think of it as a 'bad' habit.

The fact remains that many educators feel a level is reached where word and phrase recognition is so automatic that no subvocalization response occurs. "For the good reader there seems to be no intermediate phonological level of processing" (Saville-Troike,1973:397). Few researchers are entirely convinced, most commonly expressing that there are "verbal responses required in...most, if not all, reading" (Geyer,1970:77). Edgefelt (1959) offers evidence that even advanced readers subvocalize to some degree during silent reading. An examination of the 'reading for meaning' practiced by advanced readers offers an explanation for all these phenomena.

While reading for meaning, the good reader extracts comprehension of the whole by cueing off of key words,

phrases, and sentences. The reader may skim or skip over portions of text that they already comprehend or that are irrelevant to their reading purpose. Redundancy in written and spoken language is so high that one does not have to read word for word to get the meaning. In fact, reading for meaning is defined as comprehending the message by focusing on key elements without reading word for word. It is, in reality, skimming. To the extent that good readers only focus on key words, phrases, and sentences they would only subvocalize key words, phrases, and sentences.

The strongest proof for the subvocalization hypothesis exists in the neurophysiological make-up of the brain. An ingrained conditioned response, such as subvocalization, is not skipped nor circumvented, it is sublimated. It becomes so automatic and subliminal that it often goes unnoticed. Memory is typically accessed in the manner and context in which it was recorded. In short, memories come out via the same path they went in. After a lifetime of conditioning a neuronal pathway through the symbol-sound-sense reading progression, the brain does not suddenly bypass that neuronal pathway. The subvocalization response to the reading stimulus instead becomes sublimated to the point that many readers are no longer aware of their inner speech.

Traditionally used techniques to improve reading speed, such as self pacing and visual pacing devices, would force the reader to speed subvocalization, if our hypothesis is correct. As early as 1940, Goldstein found that fast readers could comprehend speech at a faster word rate than slow

readers. Orr,Friedman,& Williams (1965) confirmed this correlation between reading rate and the ability to comprehend compressed speech. It follows logically that, if one had the productive subvocal ability inherent in faster reading, one would certainly have the receptive ability of comprehension at faster listening speeds. Mignerey (1975) examined this relationship and found that learners' ability to comprehend TCS was a predictor of their ability to gain in reading rate under a program of speed reading instruction. Conversely, Hoatson (1978) found that after giving subjects three weeks training in rapid reading, their comprehension of TCS was better than that of an initially equal group who received no speed reading instruction. More research along these lines is called for, but what there is supports our hypothesis that subvocalization is an inherent part of rapid reading skill. Although the subvocalization connection has not been extensively studied, the transfer of skill from listening to reading has.

The evidence for transfer of auding training to reading ability was analyzed by Sticht (1974). He examined 31 studies using strict criteria for validity of the transfer effect. Other than appropriate use of the scientific method, the formula required pre testing in auding and reading, training in auding, measurement of the effectiveness of auding training, and post training measurement of reading to assess transfer effect. Eleven studies failed to post test auding ability to determine if the training has been effective. Seven more achieved no improvement in auding ability and, of course, no transfer effect. Of the 12 remaining

studies, 10 showed auding improvement and the transfer effect, improvement in reading. Only two of these showed improvement in auding with no transfer of skill to reading. Overall, this is fairly strong support for the hypothesis that training in listening skill transfers to reading skill.

Summary and Generalizations

In summary, we must first review the practicality of listening training as it relates to reading development. Theoretically, transfer theory is sound. In practice, however, it has proven to be more elusive. Of Sticht's 31 studies providing auding training, only 15 showed improvement in reading. Sticht comments that "it is not known to what extent such transfer does not occur automatically. Conditions for facilitating transfer are not dealt with, nor have we considered what types of oracy training might be most appropriate for transfer to reading when that skill is acquired" (1974:95). Subvocalization theory would suggest that transfer occurs, but is not automatic.

The symbol-sound-sense progression dictates a two step process in reading which we will refer to as the two leg analogy, see figure 7.

THE TWO LEG ANALOGY

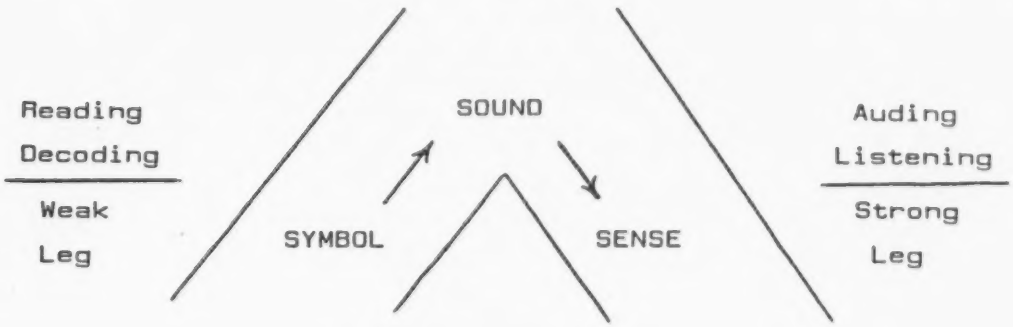


Figure 7

The two processes of symbol-sound (reading decoding) and sound-sense (auding listening) each represent one leg of the analogy. Of the two legs, the auding leg is by far the strongest in those learners who have not reached their

asymptote, a stable (optimal) level of reading comprehension approximately equal to listening comprehension. The weak leg is the symbol-sound/reading decoding process. The typical approach has been to exercise the strong leg by training in auding, often using TCS, then test the weak leg (decoding) for improvement. Very few TCS training programs have used simultaneous reading-listening. Sticht recognized this error by stating that "training in auding should not be expected to facilitate reading decoding skills. Rather, such training should impact on reading comprehension"(op.cit., p.73). What many researchers have not acknowledged is that reading decoding (subvocalization) skills are a necessary mediator in the process of reading comprehension. The two leg analogy points out the most important effect of training with TCS + text. It exercises the weak leg as well as the strong one. Listening comprehension is the superior skill, associating symbol to sound is the weak skill. The use of TCS + text links the written word to its proper pronunciation, allowing easy comprehension while conditioning a faster response to the stimulus of reading. In providing practice with the proper pronunciation prompt, TCS + text exercises the weak leg in a manner unique from and superior to any other pacing method.

Subvocalization theory states that subvocalization (reading decoding) is a normal, necessary, and important part of reading skill. We have taught reading by the phonetic decoding process then turned around and condemned it as a 'bad' habit in need of remediation. We would do better to enhance

the decoding/subvocalization process by modeling correct pronunciation of reading material by using listening tapes, associating sound to print by simultaneous reading-listening, conditioning a faster response to the reading stimulus by training with TCS, and by teaching reading for meaning technique (skimming skills) to advance the reader beyond the necessity of reading and subvocalizing word by word. Our research evaluation has shown there to be strong support for this approach. In practice, of the ten studies analyzed that tested training with TCS + text, nine showed improvement in one or more of the reading skills.* Training with TCS + text has consistently shown improvement in reading speed, vocabulary, or both with no significant loss of comprehension. (3 showed gains & one a loss in comprehension)

Generalizations

The multitude of studies concerning listening skill and TCS have been concisely reviewed by various authors (see Appendix B for three such reviews). We will discuss the generalizations of Goldstein (1940) and Friedman (1974), because they are the most thorough and accurate. Their generalizations refer to the development of listening skill and reading skills in general, and the use of TCS for listening only rather than simultaneous reading-listening.

Modes

-Listening comprehension is, in general, superior to reading comprehension.
-The superiority of listening comprehension is decidedly more marked for the easy than for the difficult materials.

*Five other studies only tested reading skills aided by TCS.

-The relative superiority of listening comprehension is in inverse proportion to the intelligence and reading speed of the groups.
-The relative superiority of listening over reading comprehension declines with increased rate of presentation.
-Reading comprehension is more variable than listening comprehension.
-Modality superiority is, to a certain extent, a function of "individual idiosyncrasy" of the subjects.
(Goldstein,1940:reprinted in Duker,1974:73-75)

Goldstein notes the inverse relationship of low and high aptitude readers, a critical consideration in dealing with pre and post asymptote readers in a mixed group. He also comments that reading becomes a more comprehensive mode as speed increases. Most likely this is because one may better appropriate one's time to the variable difficulty of different portions of text. In listening, if one does not catch the meaning, there is no second chance. In reading one may regress if necessary, balancing the time element by shorting attention to other portions of the text which require only cursory awareness for adequate comprehension. Listening comprehension, in general, is the superior modality of pre asymptote readers, whatever their age, because they are still struggling with the reading process. Goldstein's findings would indicate that the reading ability of the broad segment of the 1940 U.S. population he tested was pre asymptotic, a conclusion which is both distressing and probably valid.

Friedman, who contrasted self pacing technique with TCS training has one finding to add to our consideration of generalizations about mode.

-Self pacing behavior showed no difference from performance under externally paced conditions, both with regard to the chosen rate of presentation and ability to comprehend the material.
(Friedman,in Duker,1974:549-553)

In addition, our own evaluation of the research has found that:

> -As rate of presentation increases, reading (only) is superior to listening (only) and reading-listening is superior to both.

Initial experimentation is usually conducted with small doses of the treatment. We project that intensive training with TCS + text will surpass self pacing techniques in producing results.

Rates

> -Reading and listening comprehension show a consistent decline with increased rate.
> -The decline of reading and listening comprehension with increased rate is slight for the first few rates but becomes accelerated at the faster speeds.
> -The average decline of comprehension between the slowest and most rapid rates of presentation appears to be slightly over two annual high school grades.
> -Within the limits of the rates used in the experiment, optimum rates of presentation are not manifested for the group as a whole, or for groups segregated according to intelligence or reading speed.
> (Goldstein,op.cit.)

Obviously, optimal rate of presentation will remain a somewhat individual consideration. In addition, low and high aptitude, pre and post asymptote readers need to be handled differently.

> -Listening skill built up during experimental exposure is not retained if no intervening training is given.
> -Subjects find material presented at double normal recorded speed an acceptable way to listen.
> -The use of incremental increase in rate...is not any better than presenting all material at two & one half normal from the beginning.
> (Friedman,op.cit.)

The ability of subjects to so readily double their speed of information input indicates that both listening and reading skills are drastically underutilized. However, training must be consistent and continuing to maintain gains in listening or reading skill.

Subject Groups

-The composition of the groups is a highly significant factor in influencing comprehension achievement.
-Groups are more variable in reading than in listening comprehension.
-Groups are apparently more variable at the slower than at the faster rates of presentation, but this may be conditioned by the difference in the grade level achievement at these rates.
-The more intelligent and more rapid reading groups score higher in both reading and listening comprehension than do the less intelligent groups.
-Within each mode, the more intelligent groups score relatively higher on the difficult than on the easy passages; the reverse holds true for the less intelligent groups.
-The more intelligent and more rapid reading groups score higher for both modalities at the fastest rate than the less intelligent and slower reading groups do at the slowest rates.
-The more intelligent and faster readers (upper quartile) find reading more effective than listening...for lower quartile groups this situation is emphatically reversed. (paraphrased)
(Goldstein,op.cit.)

In short, those who read well (post asymptote), find it more effective, and those who do not read well prefer to listen. The older the subjects the more likely that categorization into low and high aptitude groups amounts to pre and post asymptote readers. With beginning readers one can only say that high aptitude readers will obviously be the first to reach asymptote. Junior high (6-9th grade) would be the most likely time to confuse aptitude with asymptote since this is the median point for reaching asymptote.

-The vast majority of students have responded positively to...compressed speech.
(Friedman,op.cit.)

The preference for higher speed TCS rather than normal speed presentations is confirmed by virtually every researcher who investigated preference.

Materials

-Passages, when properly equated by scaling, are not a significant source of variation in comprehension.
-Equivalence of passages for reading comprehension does not insure their equivalence for listening comprehension.
-The superiority of listening over reading comprehension is more marked for the easy than for the difficult passages.
-The easy passages give greater reading-listening differentials than the difficult passages, particularly for the less intelligent groups.
(Goldstein,op.cit.)

Reading is a more flexibile medium that listening because the learner has control. When study of difficult materials is called for, listening only becomes a poor choice. Goldstein used rates from 100 wpm up to only 322 wpm, the point where reading and reading-listening begin to show clear superiority (Jester & Travers,1967). His subjects were adults with an average 8th grade achievement level. His generalizations are a useful window into the language skills of the general population (1940 era). Other researchers, working with adult college students as subjects found no difference at low speeds and reading superior at high speeds.

Correlations

-Reading and listening comprehension are highly correlated.
(Goldstein,op.cit.)

-Intercorrelations between listening and reading scores generally positive.
-General language handling abilities correlate positively with compressed speech listening performance.
-Significant reading improvement in several experimental and control groups, but it should be borne in mind that the control groups also had some regular exposure to the test materials in compressed form.
(Friedman,op.cit.,referring to his own series of experiments in listening using TCS)

Obviously, general language ability, general intelligence, and scholastic achievement correlate highly. Language is ed-

ucation. It is the medium, and often the subject. However, the enhancement of reading ability gives the learner, of whatever intelligence, an edge. Many tests include more questions than the learner is expected to be able to answer (in order to test the limits of their knowledge and ability to take tests). Therefore, the faster readers score higher because they answer more questions. Friedman notes that vocabulary scores rise with reading speed, not because the subjects vocabulary increased a grade level with a couple of hours of training, but because they were able to answer more questions reading at a faster speed.

Exposure

- -Exposure to compressed material will improve comprehension of new compressed material.
- -Ten hours of exposure spread over a period of approximately one week is sufficient to achieve normal comprehension at approximately double speed for most students.
- -Ten to fifteen hours of exposure is sufficient to achieve approximately 80% normal comprehension at two and one half normal speed (425 wpm).
- -Listening to the practice materials (novels) for approximately an hour without interruption presents no difficulty.

(Friedman, op.cit.)

Friedman's studies give us some excellent information for structuring amount of training necessary to achieve results. The addition of text would have a positive effect.

Discussion

The comprehension asymptote has been variously described from two aspects thematic in the research literature. The concept was introduced by Shennum who questioned the findings from his subjects "if their phonics ability was still inadequate, the students may not have reached their asymptote of unaided reading rate and comprehension prior to training" (Shennum,1975:15). This concept that there is a certain baseline level of proficient reading comprehension for each individual is a possible explanation for the many studies that show comprehension stable (no loss/no gain) as reading speed increases (or doubles with use of TCS + test).

The second aspect of the comprehension asymptote is related to modality preference, the superiority of listening over reading in early learning. The switchover point, where reading efficiency approaches listening efficiency, suggests itself as the asymptote. Therefore, the asymptote is possibly not only an optimal level of easy reading comprehension but also that point at which it becomes as easy to read as to listen.

Too many questions remain unanswered about this critical concept! Is this the explanation for the comprehension scores remaining flat while training boosts other reading skills? Are the two aspects evidenced in the literature one single dynamic? Is there a crux point in the acquisition of reading skill, or is it an artifact of evaluation procedures and statistical analysis? How can we measure a reader's proximity to their asymptote? What is the best way to handle

pre and post asymptote readers? At present, we can only offer educated guesses.

We suspect that low aptitude/pre asymptote readers will show improvement in comprehension as well as vocabulary and reading speed; while high aptitude/post asymptote readers will show no increase in comprehension but larger gains than the other group in reading speed, and possibly vocabulary (so much depends upon initial vocabulary level to begin with). Both groups should be handled quite differently, with post asympote readers starting at double normal reading rate and increasing from there. Pre asymptote readers may well need to start with slowed speech plus text gradually incremented along comprehension criteria that will need to be established. An individualized program promises to be the most effective, but working with group programs should work, nonetheless. The theoretical and practical complexities of working with pre and post asymptote readers should not daunt us from the task. For here is the point of impact, where what we do may have the most enormous impact upon a young learner's education and opportunity for the future. Ongoing research is a necessity to come to grips with this comprehension dynamic.

The question of how to best deal with low/high aptitude or pre/post asymptote readers requires us to think in terms of rate alteration rather than time compression. Harvey (1984) states that the midpoint of the language learning process is where rate alteration is most crucially effective. Although he is referring to second language learning, his

comments are relevant to language learning in general.

> The cruciality of each task depends heavily on their proficiency in the target language over time. That is, grapheme/phoneme correspondence seem to be crucial during the very early stages of comprehension learning but grow less critical to a given learner as a specific, conscious-level strategy, as he or she becomes more and more proficient. Good readers do not read letter by letter, good listeners do not process word by word; they process by larger and larger "chunks", up to and including whole paragraphs. It is also clear that the application of rate-alteration technology to the curriculum varies with the second-language proficiency of the student. However, it will be noted that its use is more crucial toward the mid-point of the process than at the beginning or at the end. Beginning second-language learners lack so much requisite knowledge of the language, especially vocabulary, that no matter how far a selection is expanded, unless the words are already learned, comprehension cannot occur. Likewise, fluent readers and listeners can comprehend at speeds as great or greater than those produced by speeech compresssion and really have no need to rely on any machinery to assist them at this point.
> (Harvey,1984:39, also chart in Figure 8,below)

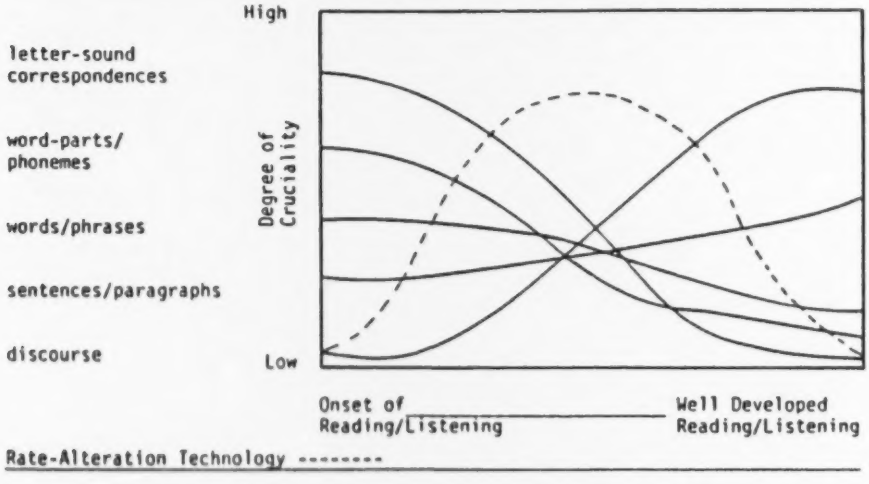


Figure 8 - Language Access Unit (ibid.)

As Harvey intimates, the use of rate alteration technology should lead into development of reading for meaning skills as a natural next step. Harvey's illustration of rate alteration technology helps clarify the differential effectiveness of the modes of listening, reading, and reading-listening.

Both listening and reading modes have drawbacks as rate of presentation increases. With listening, if one fails to comprehend immediately, it is impossible to dwell upon or regress for more difficult sections of the presentation. The listening mode lacks the flexibility to allow a slower focus, or conversely, to speed ahead by scanning, and skim or skip text that is already understood or irrelevant to one's purpose. With reading, one encounters the subvocalization barrier where any words that are unfamiliar or difficult to pronounce are stumbling blocks to rapid and effective reading. Reading decoding is the weak leg for all readers until asymptote is reached. If both modalities are used simultaneously these weaknesses are neutralized. Correct enunciation training is provided along with text that allows the necesary flexibility to regress briefly or scan ahead when appropriate. In reality, skimming and scanning technique form the basis of 'reading for meaning'. These valuable reading skills can be taught as training with TCS is faded, cut off gradually allowing the reader to progress on their own.

The research shows that information processing by reading (or listening) is seriously underutilized. How else can we characterize the ability of untrained learners to double their learning efficiency index by doubling their reading speed with no loss of comprehension using TCS + text? We will refer to this underutilization effect as the slack factor. The slack factor deserves serious consideration because of its interaction with testing syndrome, experimental effect, and suggestive mental set. Reading performance on

tests often jumps above normal reading performance. The fact of participating in an experiment has a positive effect on performance, regardless of the treatment. Suggestion, also affects the outcome in that what the learner accepts as possible they can achieve. With so much slack, so much underutilized ability, any of these factors could affect the outcome of experimental groups. More confusing still, they may equally affect control groups. The slack factor must be carefully controlled for in experimental design.

Training with TCS + text shows promise as an effective training tool to improve reading skills. It has shown itself to increase learning efficiency when used as a study aid. Improvement in reading speed, vocabulary, or comprehension has a direct and positive effect on scholastic achievement. The use of TCS + text affects motivation, in that learners express a preference for it over normal speed presentations. This research evaluation recommends the continued study and development of training programs using TCS + text for reading improvement or as a study tool for academic subjects themselves.

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MILES R. JONES, PH.D.

Doctor Jones brings Trajectoires Associées still more expertise in educational media, project administration, teacher training, and curriculum development. As Associate Director of the Lozanov Learning Institute of Dallas, Texas he became a prominent consultant and teacher trainer in Suggestopedia and accelerated learning. He has also served as Language Training Specialist for the U.S. Defense Language Insitute; Professor of English at the Air Defense Academy in Sana'a, Yemen; English Training Manager for Ford Motor Company's assembly plant in Hermosillo, Mexico; and Product Development Research Consultant for World Book Encyclopedia. Most recently he served as the Head of the English Basic Skills Center of the United Arab Emirates University. He graduated from the University of Texas at Austin with a doctorate in Foreign Language Education and holds a Master's Degree in Bilingual Education and a Bachelor's Degree in Languages and Linguistics from Antioch University. He is the author of numer ous books, tapes, films, and articles on Suggestopedia, rapid language acquisition, and memory training.